Tidal Currents in the Piscataqua River, NH

Preliminary findings from the 2007 National Current Observation Program Survey

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&
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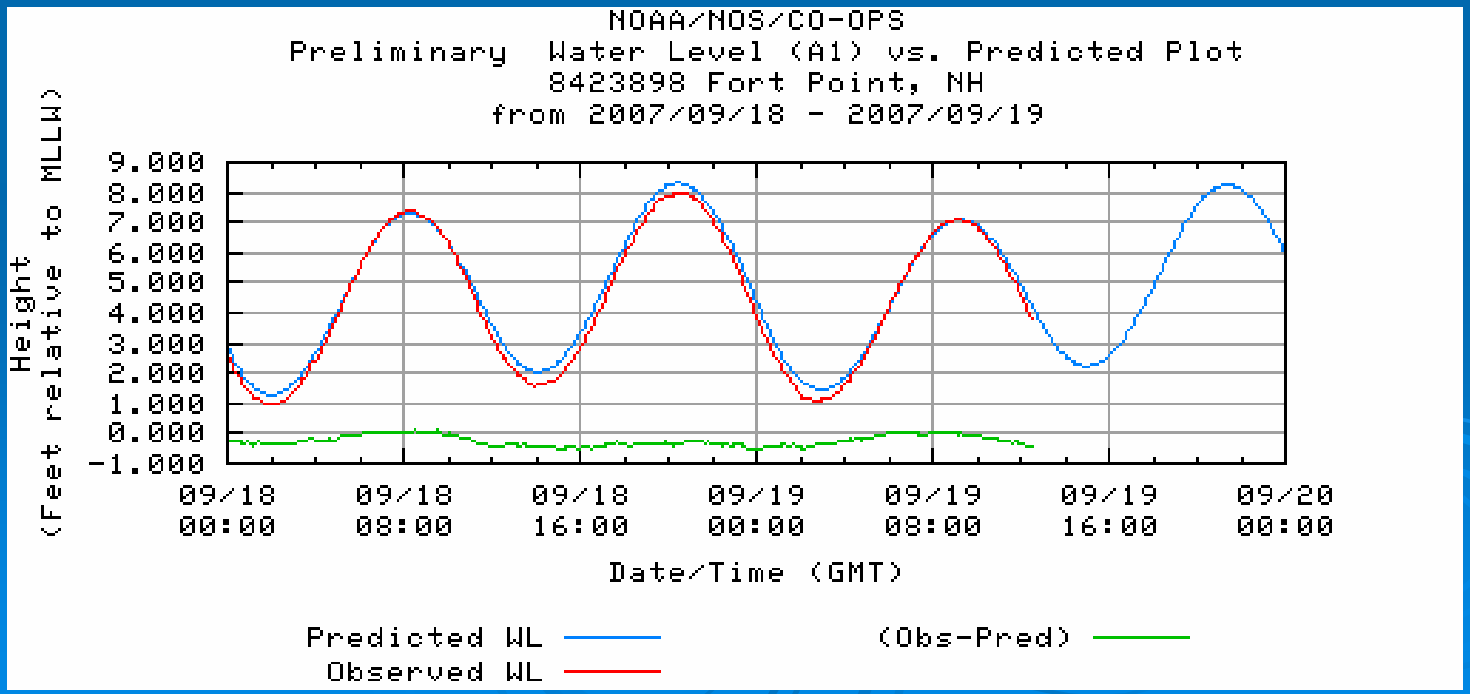
Topics

- A very brief introduction to tidal theory
- The NOAA survey
  - Background
  - Locations
  - Equipment
  - Data and preliminary analysis
- Q&A

A Brief Introduction to Tidal Theory

- What are tides?
  - What are tidal currents?
- What generates tides and tidal currents?
- How do we predict tides and currents?

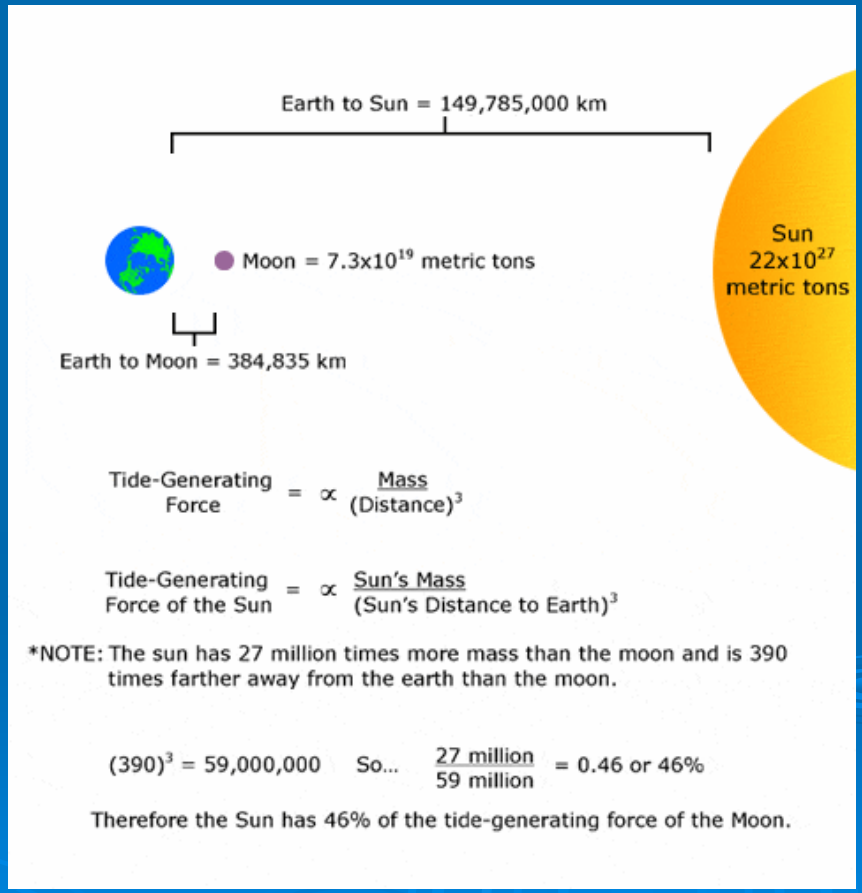


Tides & Tidal Currents

- Tides are the periodic rise and fall of water due to the moon and sun's gravitational pull.
  - Water levels are the total level of the water including tidal and non-tidal forcing (typically meteorological effects such as winds, storm surge, barometric pressure).
- Tidal currents are the horizontal movements of water due to the same forces as the tides.
  - Currents are the total currents observed, including tidal and non-tidal currents (freshwater run-off, wind forced, density driven, etc).

Tide Generating Forces: Sun and Moon

- Tides are generated by the gravitational attraction between the moon or sun and the waters of the Earth.
  - The tide generating force of the moon is over twice that of the sun.
  - The lunar day is ~24h 50 min, and a lunar month is ~28 days.
- Since we know where the sun and moon are going to be at a given time, we can predict the tides.



Tidal Theory

- Using harmonic analysis, we resolve up to 175 “constituents” which make up the tide and tidal currents.
- Since many combinations of constituents go into how tides are generated, observations are required … the longer the better.
  - Observations over a month, will resolve most of the major constituents for tidal currents.

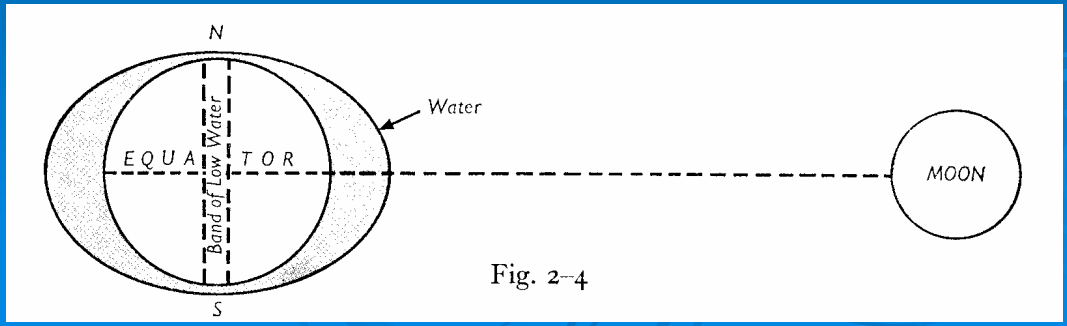
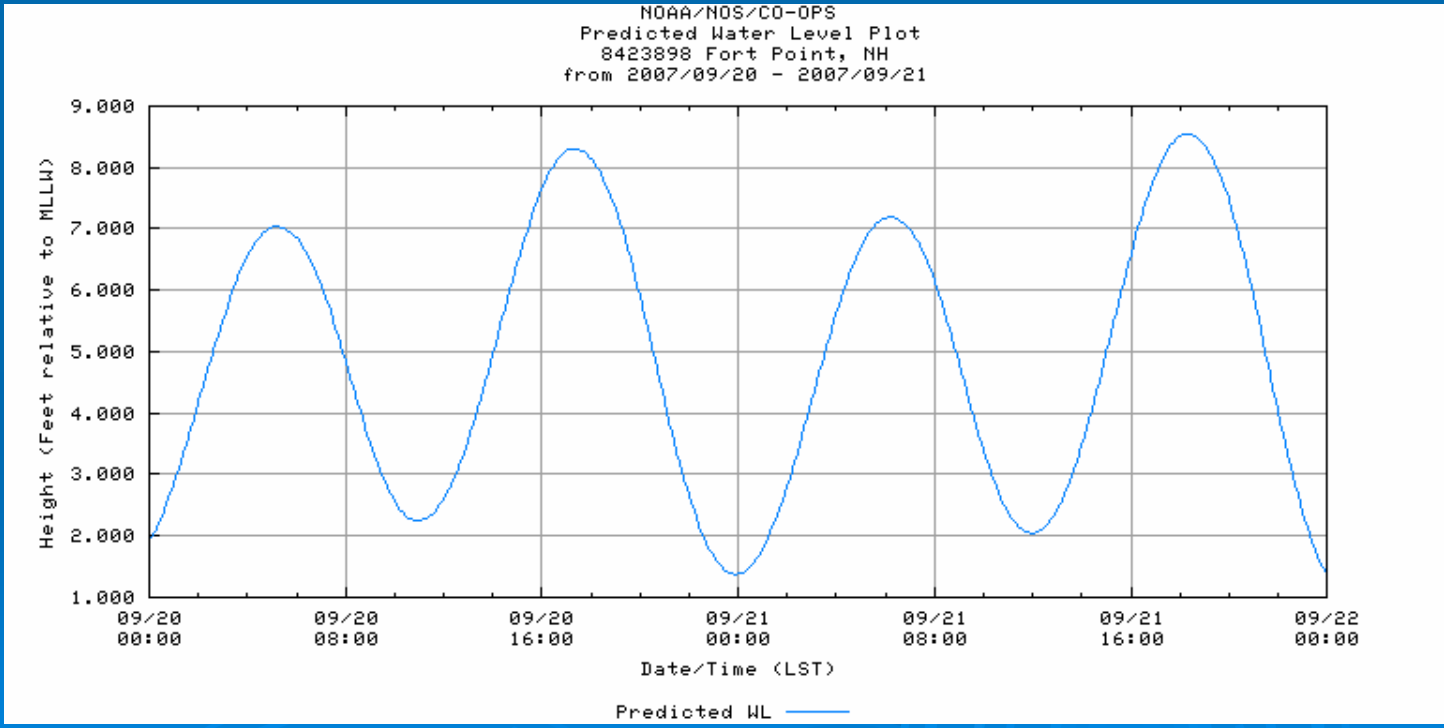


Fig. 2–4

Predictions: Tides

- Tides are scalar and are predicted with a time and a height.

09/20/2007 Thu
05:55AM LDT 7.0 H
11:49AM LDT 2.2 L
06:04PM LDT 8.1 H
09/21/2007 Fri
12:42AM LDT 1.5 L
06:55AM LDT 7.0 H
12:49PM LDT 2.1 L
07:05PM LDT 8.2 H



Predictions: Tidal Currents

- Currents are vectors and predictions have to include time, speed and direction.

Fort Point
Predicted Tidal Current January, 2007
Flood Direction, 350 True. Ebb (-)Direction, 130 True.
NOAA, National Ocean Service

	Slack Water	Maximum Current		Slack Water	Maximum Current		Slack Water	Maximum Current		Slack Water	Maximum Current		Slack Water	Maximum Current	
Day	Time h.m.	Time h.m.	Veloc knots	Time h.m.	Time h.m.	Veloc knots	Time h.m.	Time h.m.	Veloc knots	Time h.m.	Time h.m.	Veloc knots	Time h.m.	Time h.m.	Veloc knots
1		0055	-1.9	0436	0649	+1.6	1037	1342	-2.3	1730	1933	+1.2	2308		
2		0154	-1.9	0530	0743	+1.6	1129	1437	-2.3	1823	2033	+1.2			
3	0003	0249	-1.9	0622	0834	+1.6	1218	1526	-2.4	1912	2124	+1.2			
4	0055	0339	-1.9	0712	0922	+1.6	1305	1610	-2.3	1959	2206	+1.3			
5	0143	0424	-1.9	0800	1006	+1.4	1349	1651	-2.3	2044	2246	+1.3			
6	0230	0508	-1.8	0847	1049	+1.4	1431	1731	-2.2	2128	2325	+1.3			
7	0314	0550	-1.8	0935	1133	+1.3	1512	1811	-2.1	2211					
8		0006	+1.3	0358	0634	-1.7	1023	1217	+1.2	1552	1853	-2.0	2254		
9		0049	+1.2	0442	0719	-1.7	1113	1302	+1.1	1633	1937	-1.9	2338		

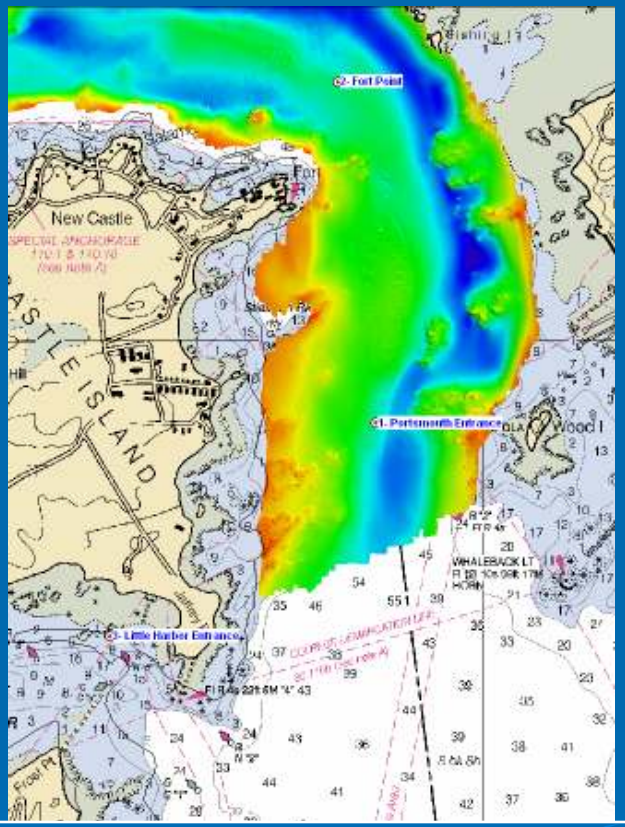
NOAA's Survey of the Piscataqua River, 2007

- 11 sites occupied
- 8 have been recovered
- 3 have not:
  - Memorial Bridge
  - Frankfort Island
  - General Sullivan Bridge
  - Divers will be attempting to recover the stations as early as Monday.

Locations – Portsmouth Entrance

Reference station (Portsmouth Harbor Entrance) will be deployed for 70+ days and will have an additional battery pack

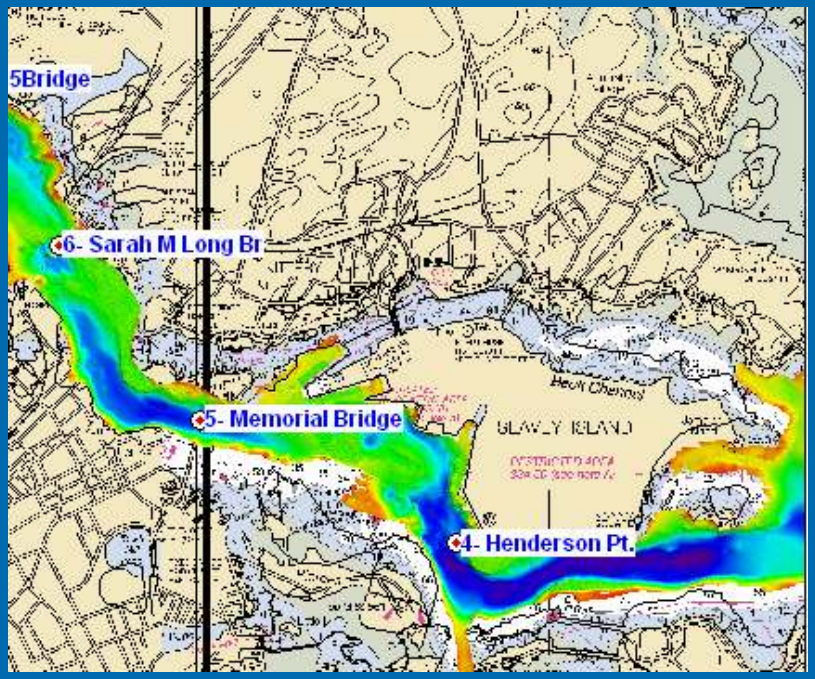
Secondary Stations will be deployed for 35+ days



NAME	LAT	LON	Z (m)	Freq kHz	# Bins	Bin Size (m)	Pings	Std Dev cm/s	Batt %	Deploy ment	Dura
1- Portsmouth Entrance	43.06333	70.705	15.9	600.0	20	1	180	0.46	0.7	1st	70
2- Fort Point	43.0745	70.707	16.8	600.0	20	1	180	0.46	0.7	1st	35
3- Little Harbor Entrance	43.05617	70.71667	7.6	1200.0	20	0.5	180	0.45	0.7	1st	35

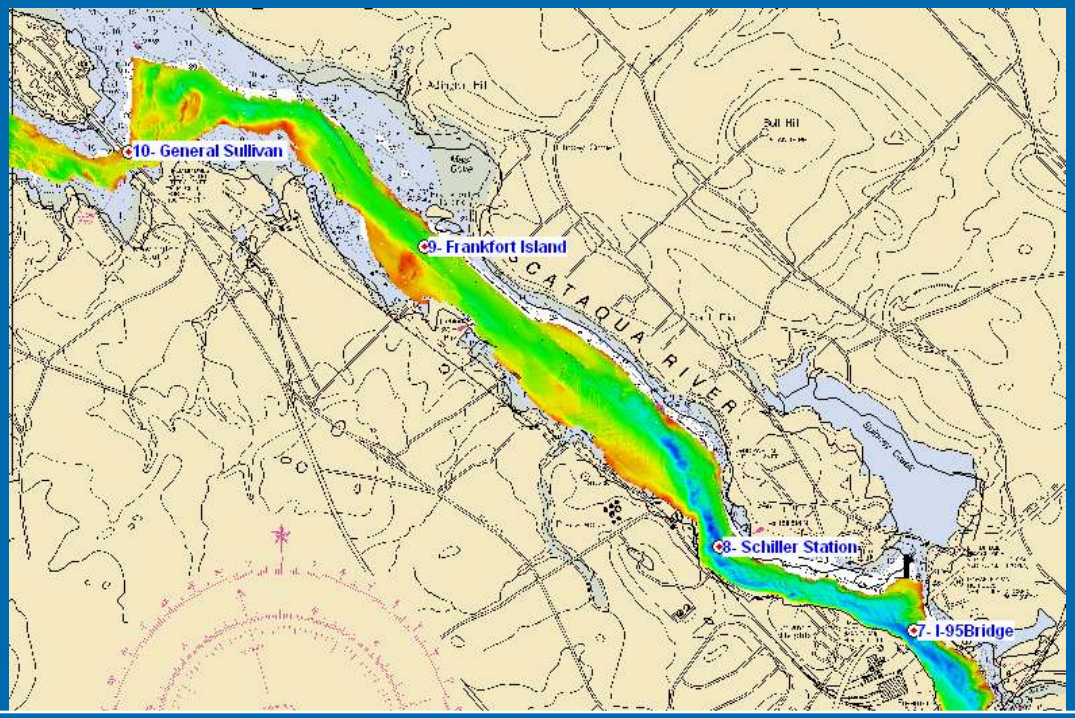
Locations - Piscataqua River

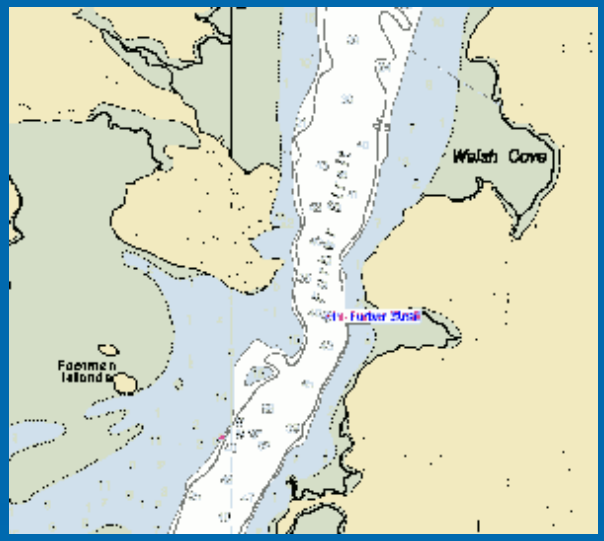
Henderson Pt. to Sarah Long



NAME	LAT	LON	Z (m)	Freq kHz	# Bins	Bin Size	Pings	Std Dev cm/s	Batt (%)	Deployment	Dura
4- Henderson Pt.	43.07483	70.73883	23.8	600.0	30	1	180	0.46	0.7	1st	35
5- Memorial Bridge	43.0795	70.75283	23.8	600.0	30	1	180	0.46	0.7	2nd	35
6- Sarah M Long Br	43.08633	70.76067	21.3	600.0	25	1	180	0.46	0.7	1st	35
7- I-95Bridge	43.09283	70.7665	22.9	600.0	30	1	180	0.46	0.7	1st	35

Locations - Piscataqua River I-95 to Dover Pt.

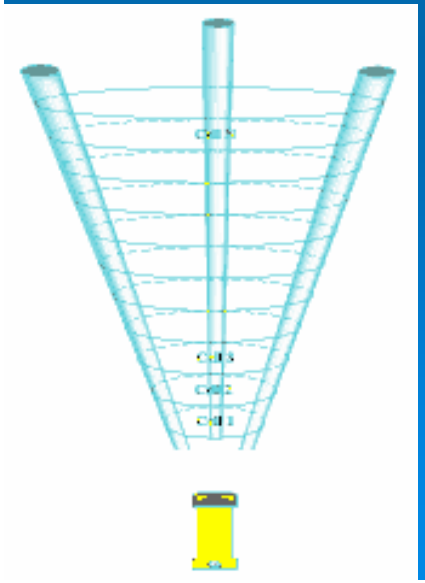




NAME	LAT	LON	Z (m)	Freq kHz	# Bins	Bin Size (m)	Pings	Std Dev cm/s	Batt (%)	Deploy ment	Dura
8- Schiller Station	43.09717	70.78117	20.7	600	25	1	180	0.46	0.7	2nd	35
9- Frankfort Island	43.11317	70.8035	14.9	600	20	1	180	0.46	0.7	2nd	35
10- General Sullivan	43.118	70.82567	7.3	1200	25	0.5	180	0.45	0.7	2nd	35
11- Furber Strait	43.08883	70.862	14.3	600	35	0.5	210	0.78	1	2nd	35

Equipment

- 600 kHz RD Instruments ADCP
  - 47m range in std mode
  - 67m range in Long range mode
- 1200 kHz RD Instruments ADCP
  - 14m range in std mode
  - 19m range in Long range mode

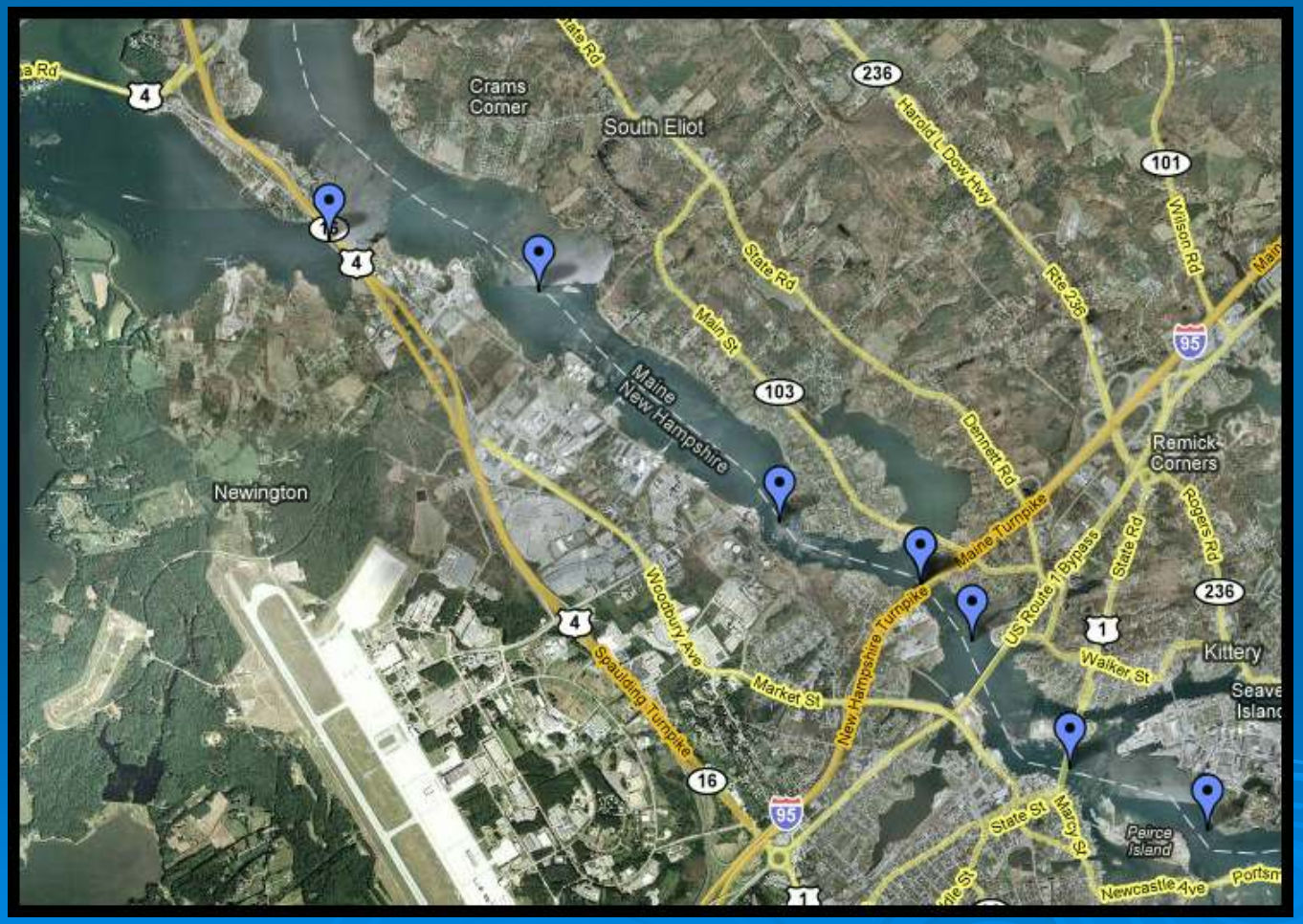


Equipment

- Trawl-resistant bottom mount
  - COTS platform
  - Benthos 867-A transponding release
- ES-2
  - CO-OPS in-house design (Eddie Shih)
  - Benthos 875 Popup release

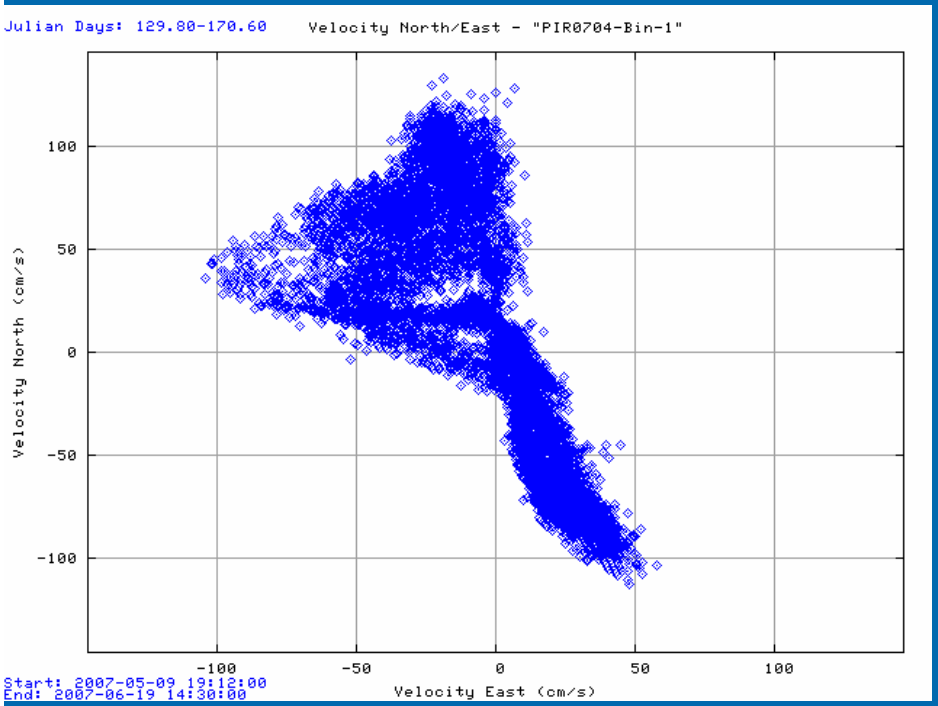
All Platforms will have Benthos Acoustic Locators (‘Pingers’)

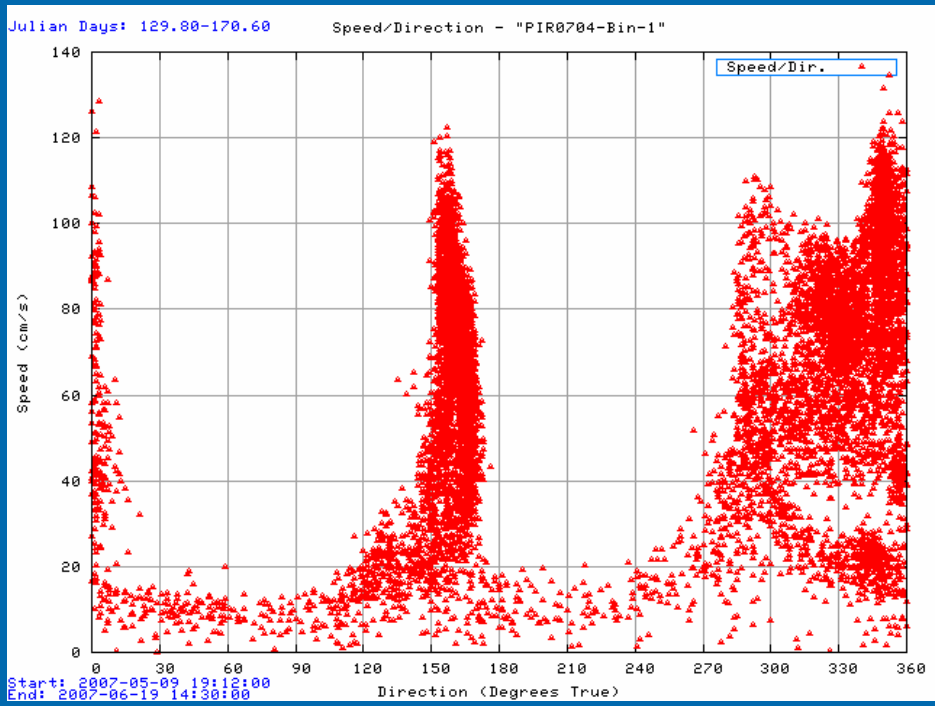
Data and Preliminary Analysis

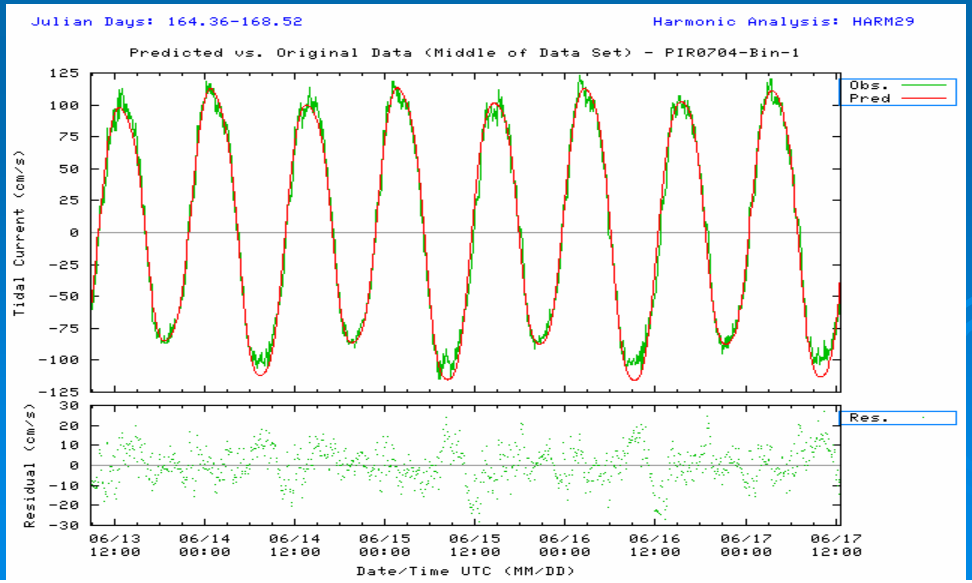


Henderson Point

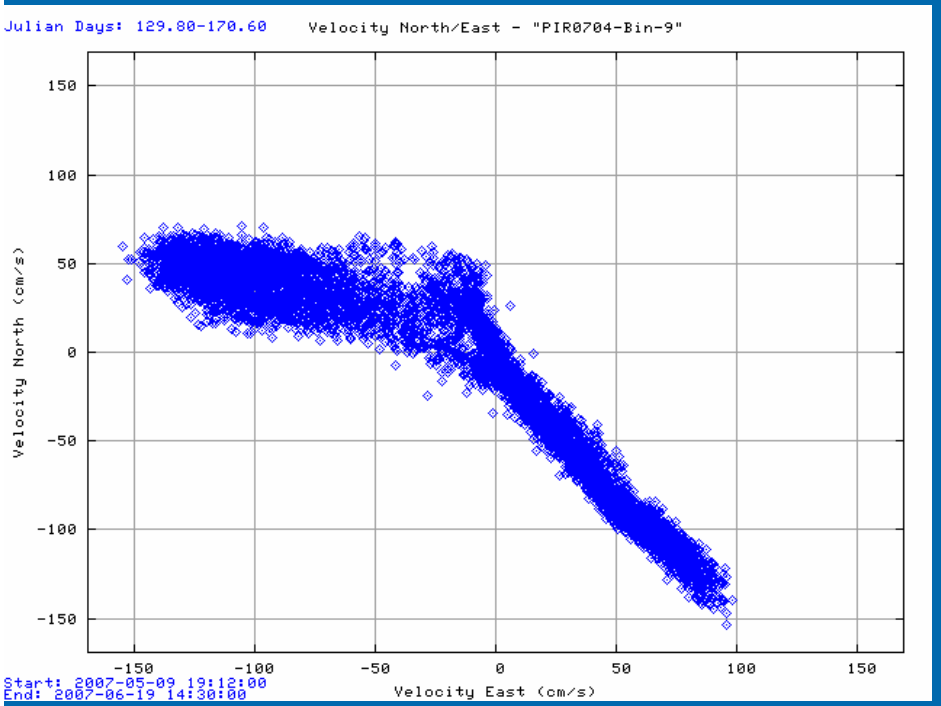
Henderson Point- bin 1(58 ft below MLLW)

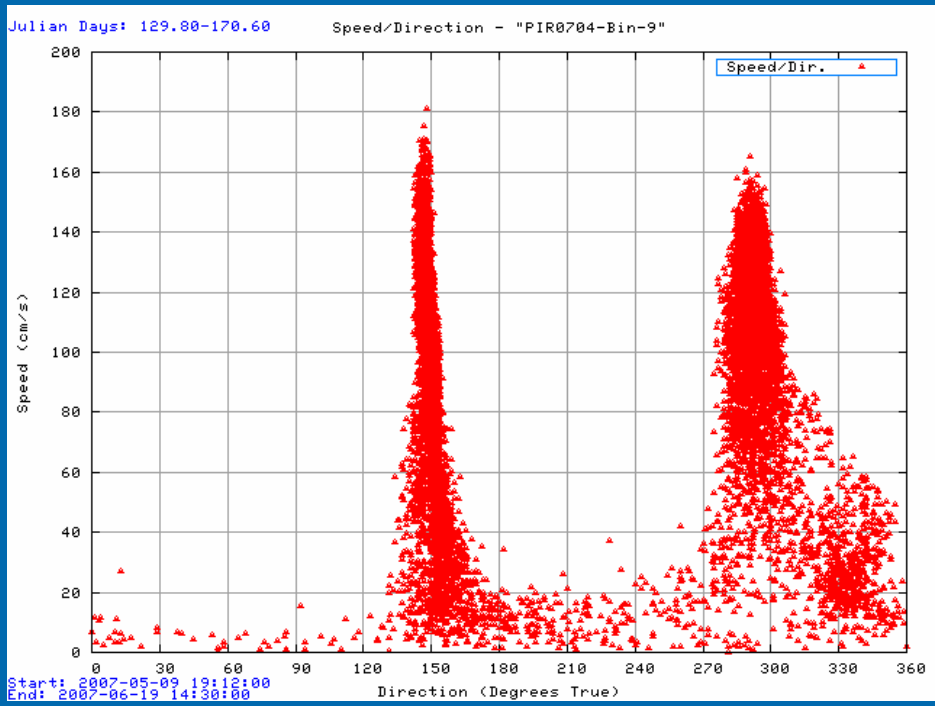


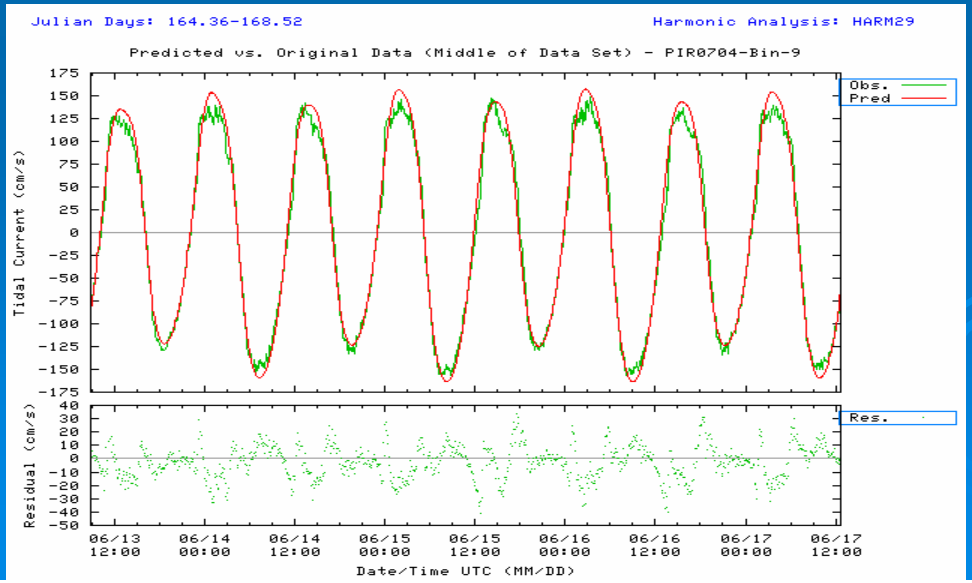




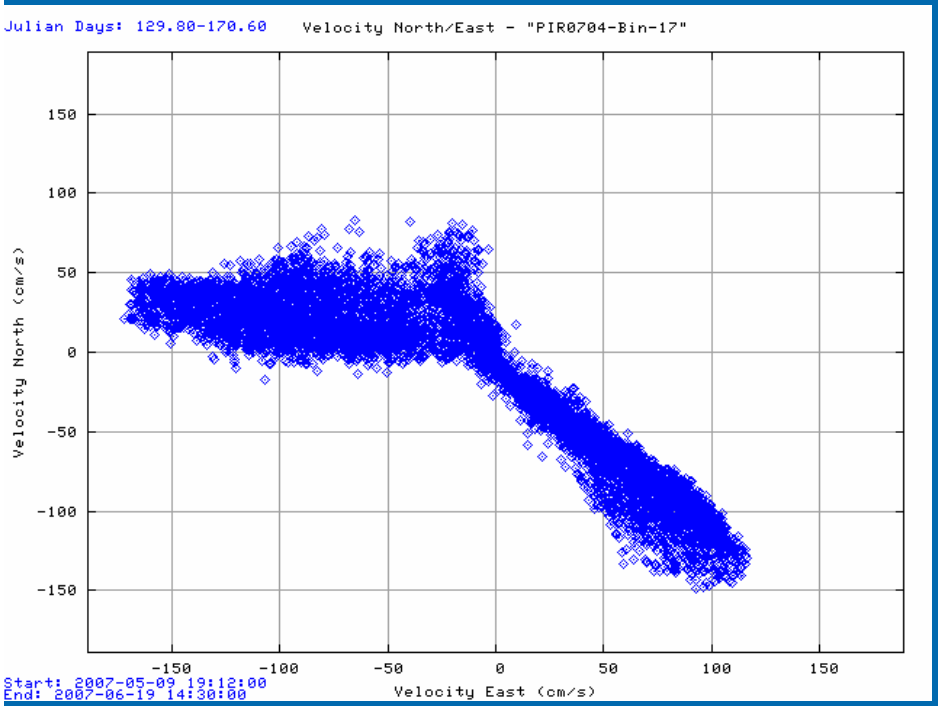
Henderson Point- bin 9 (32 ft below MLLW)

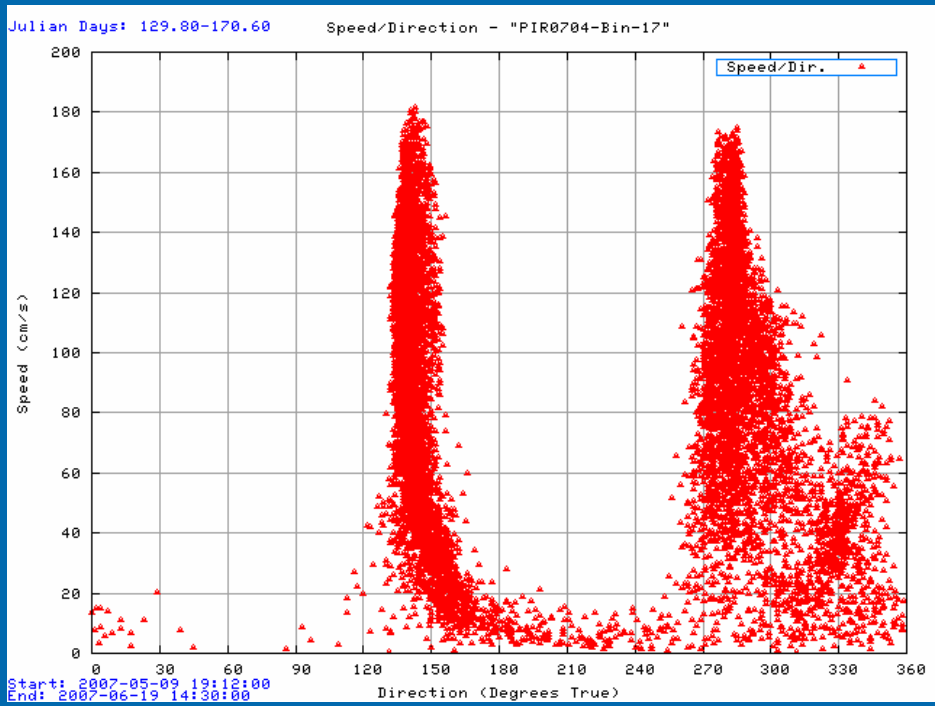


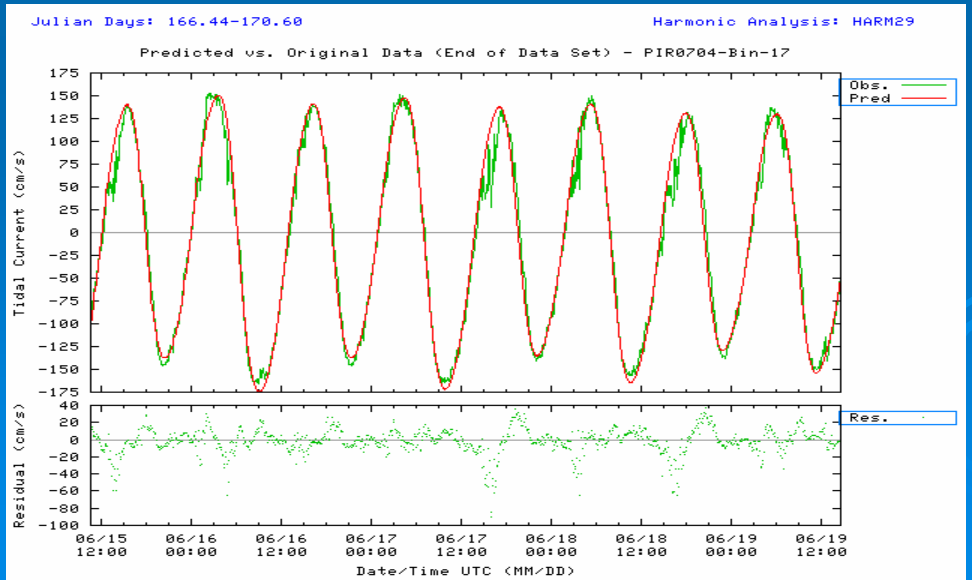




Henderson Pt. -bin 17 (uppermost good bin: 6ft below MLLW)

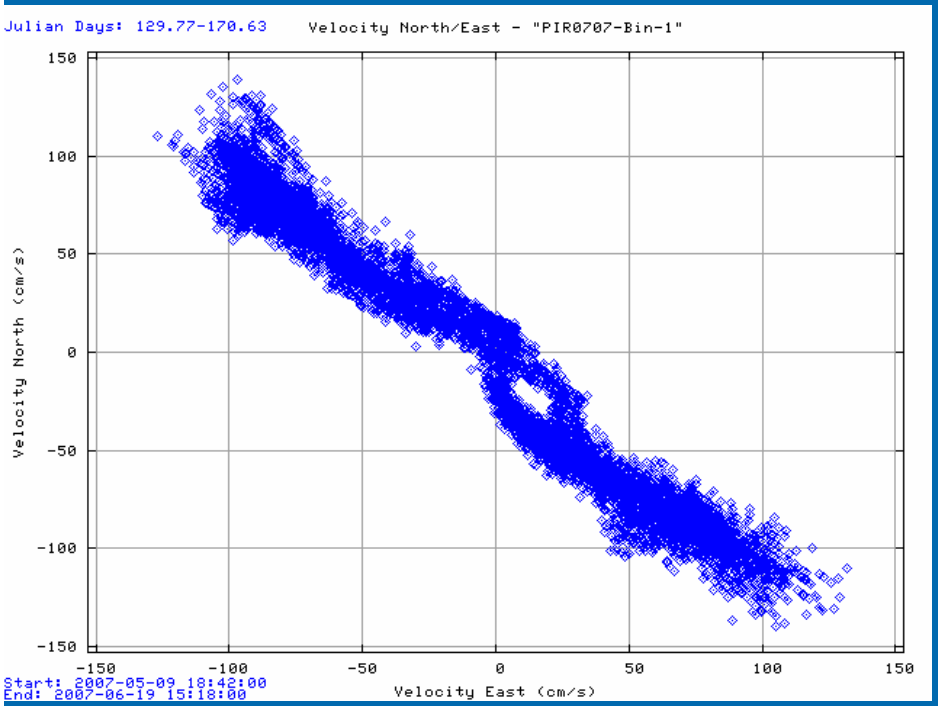


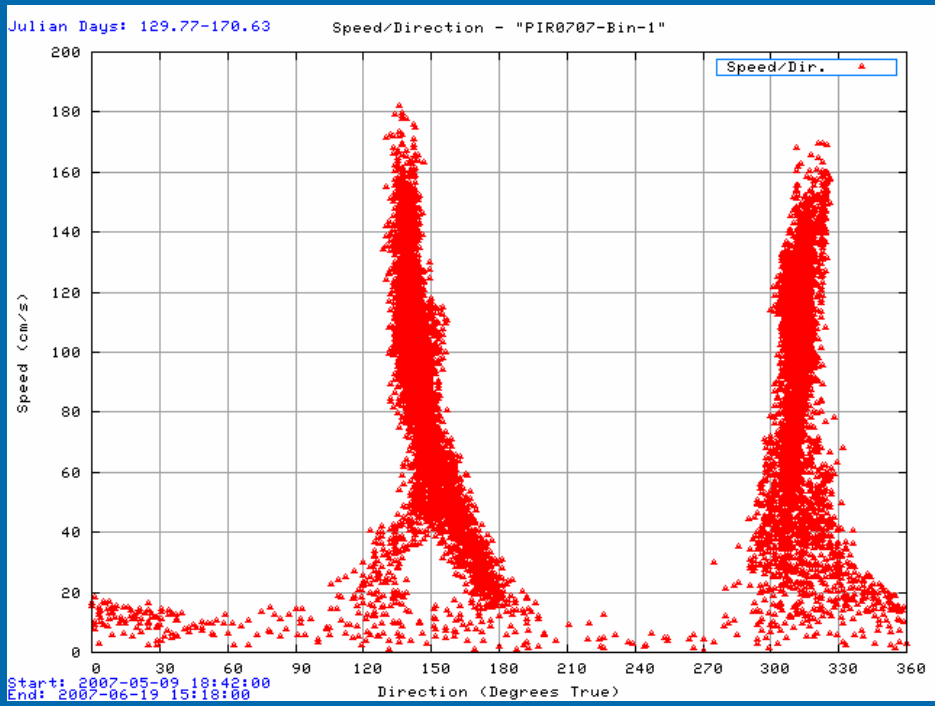


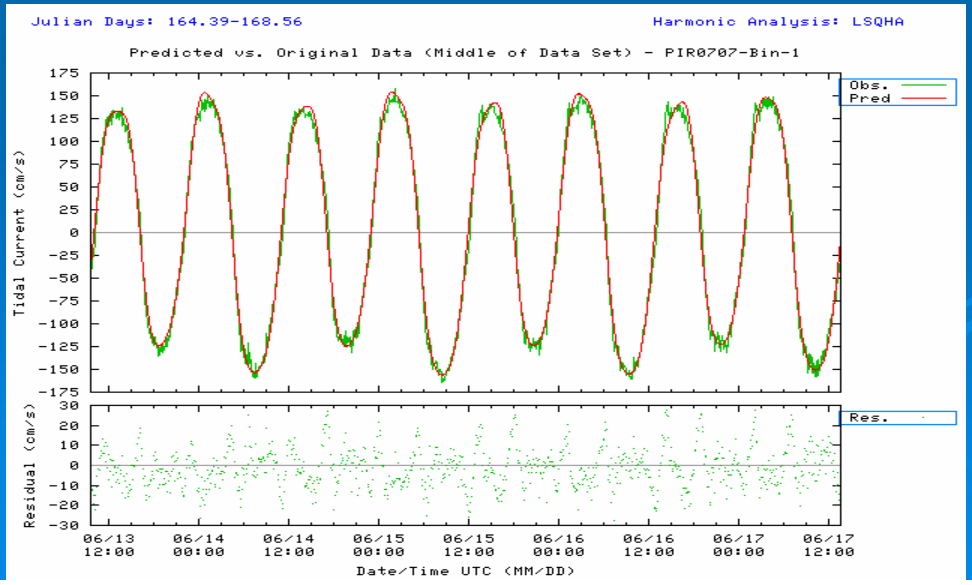


I-95

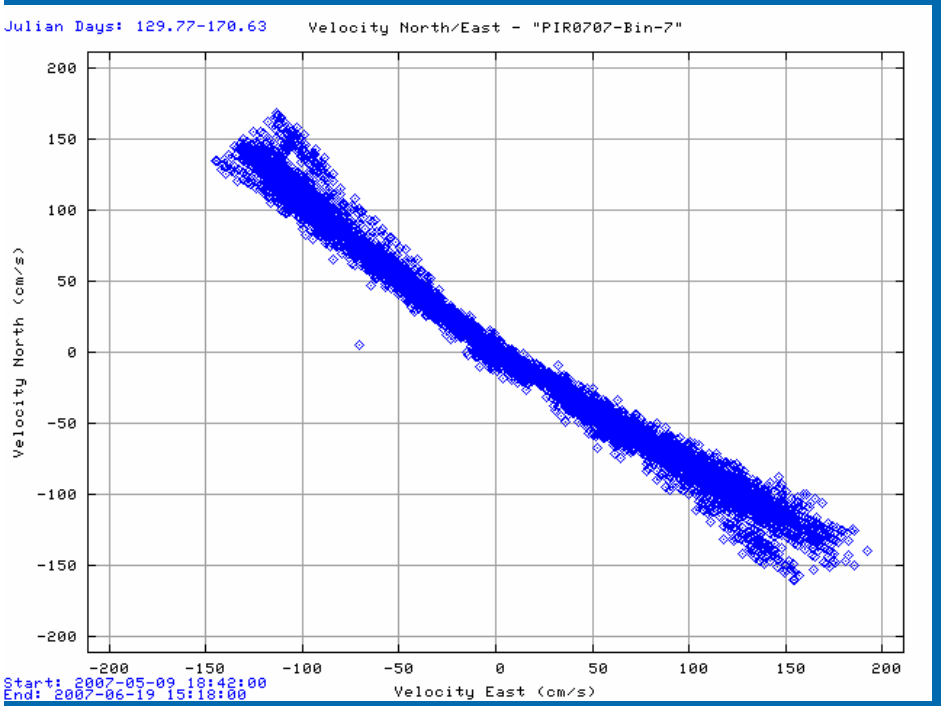
I-95 Bridge- bin 1 (48 ft below MLLW)

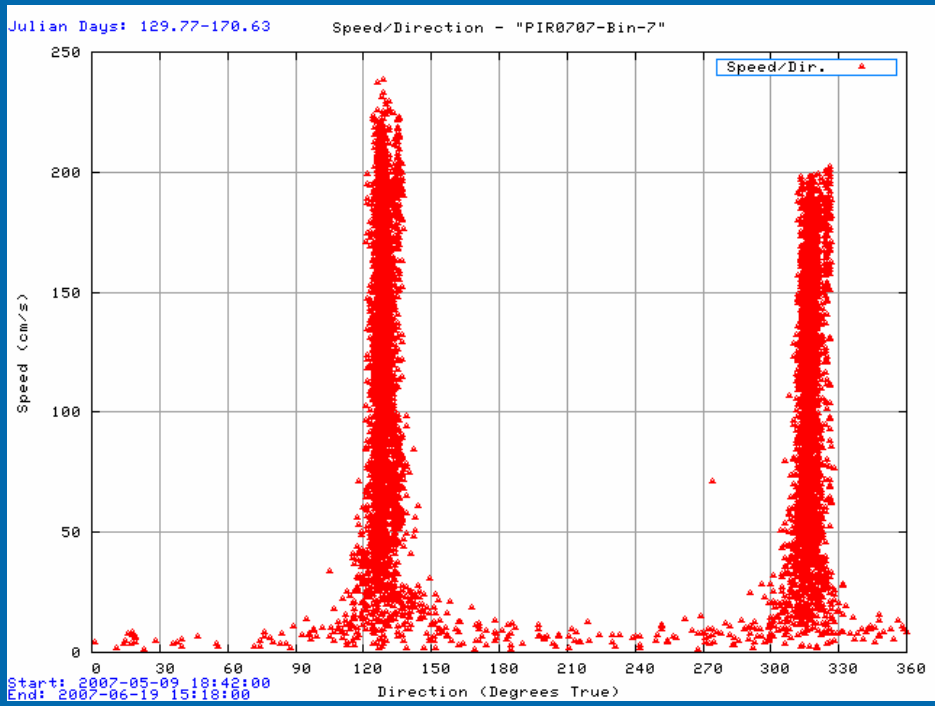


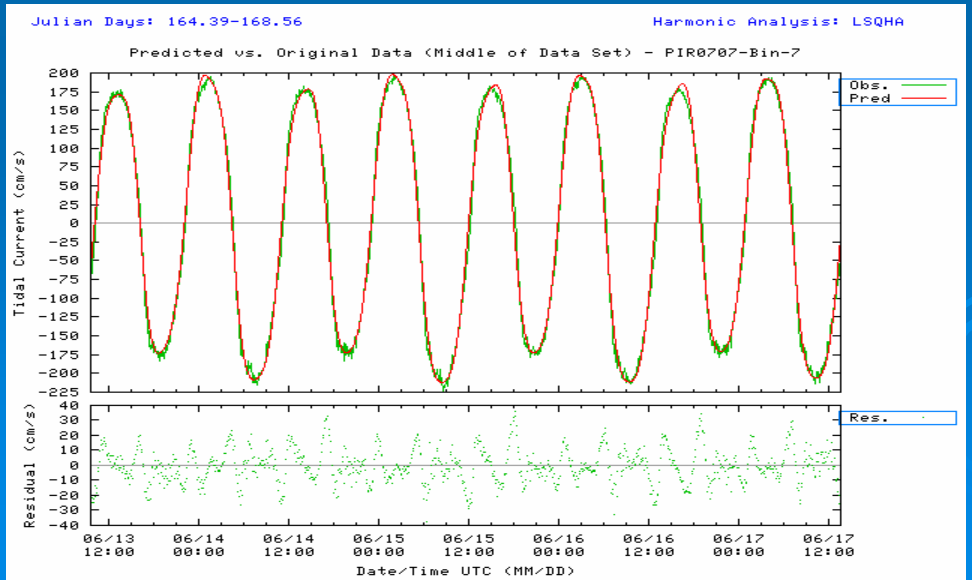




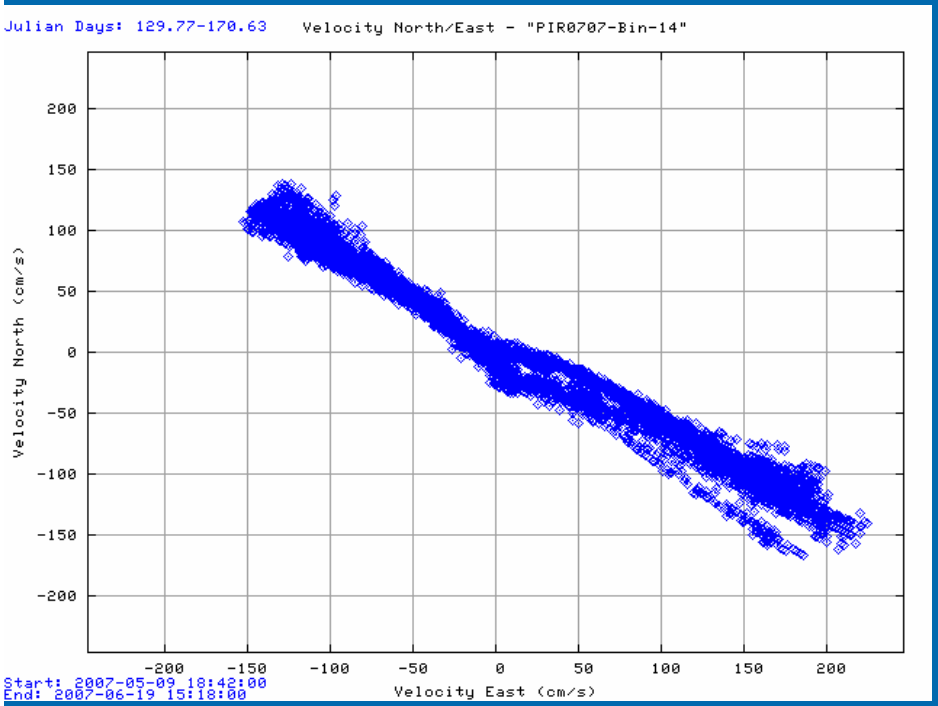
I-95 - bin 7 (28 ft below MLLW)

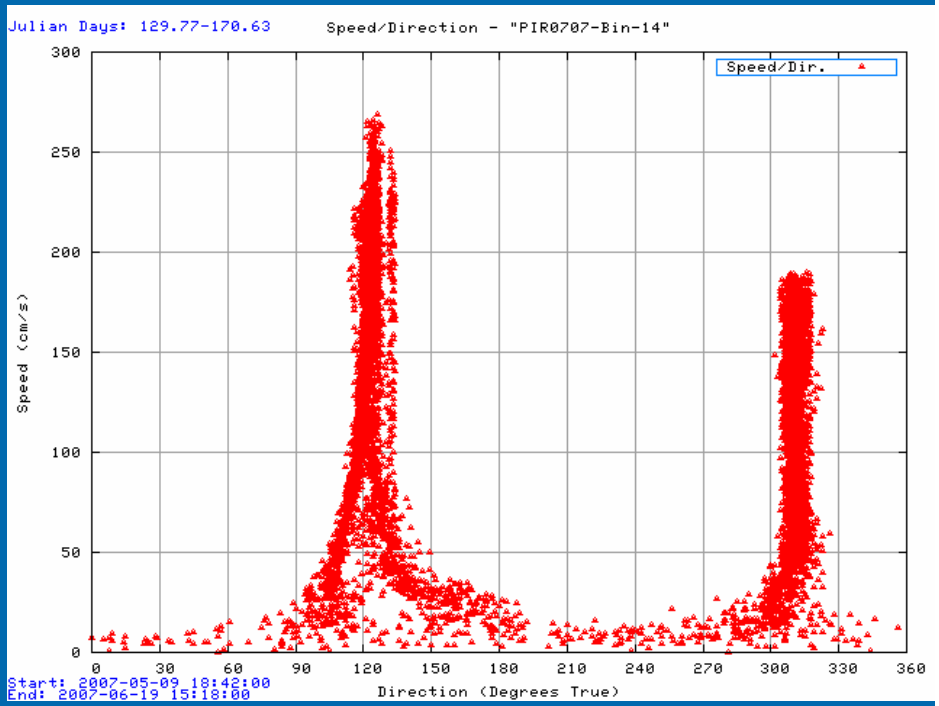


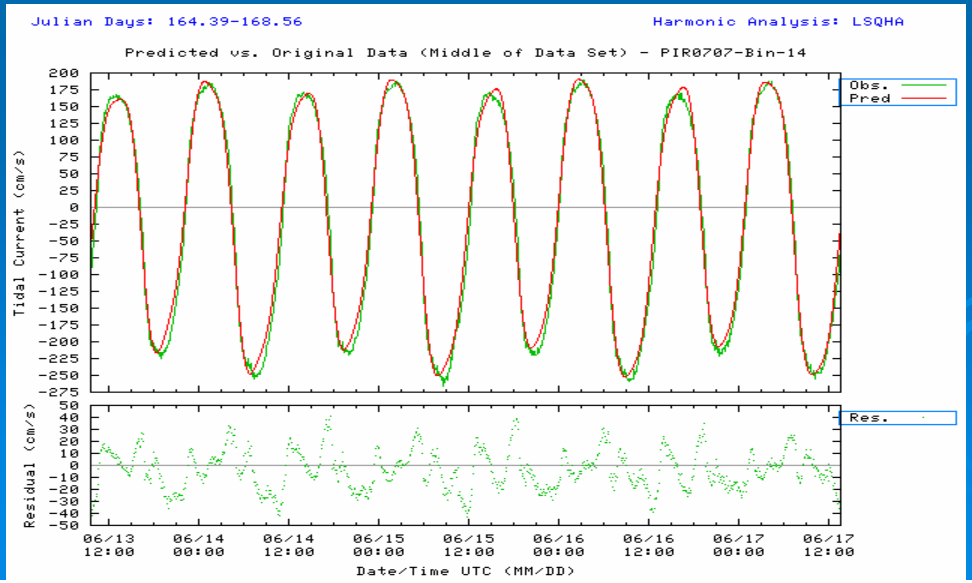




I 95 - bin 14 (uppermost good bin: 5 ft below MLLW)

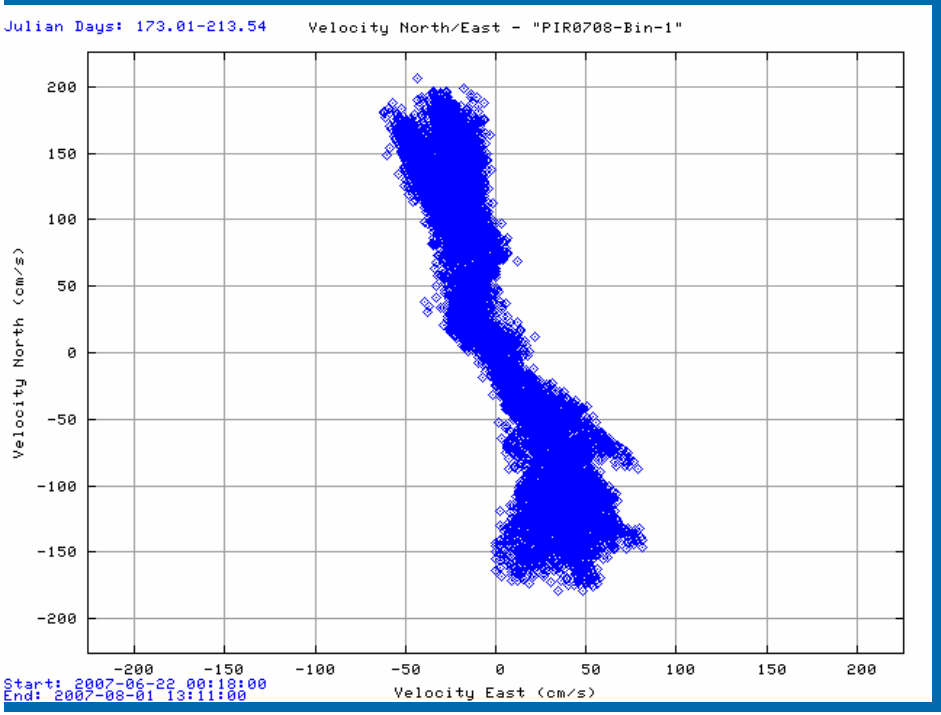


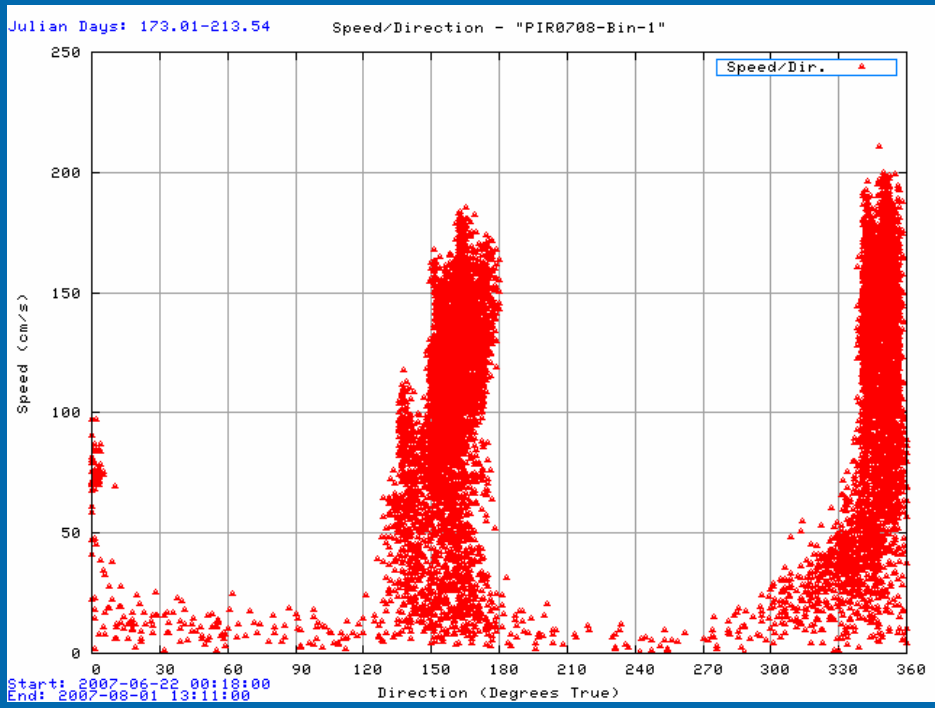


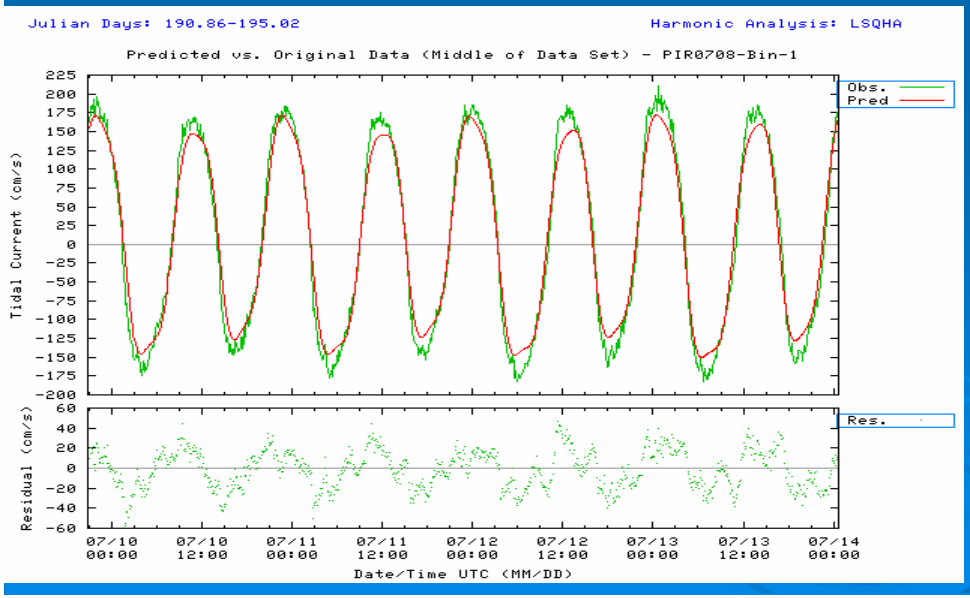


Schiller Station

Schiller Station -bin 1 (52 ft below MLLW)





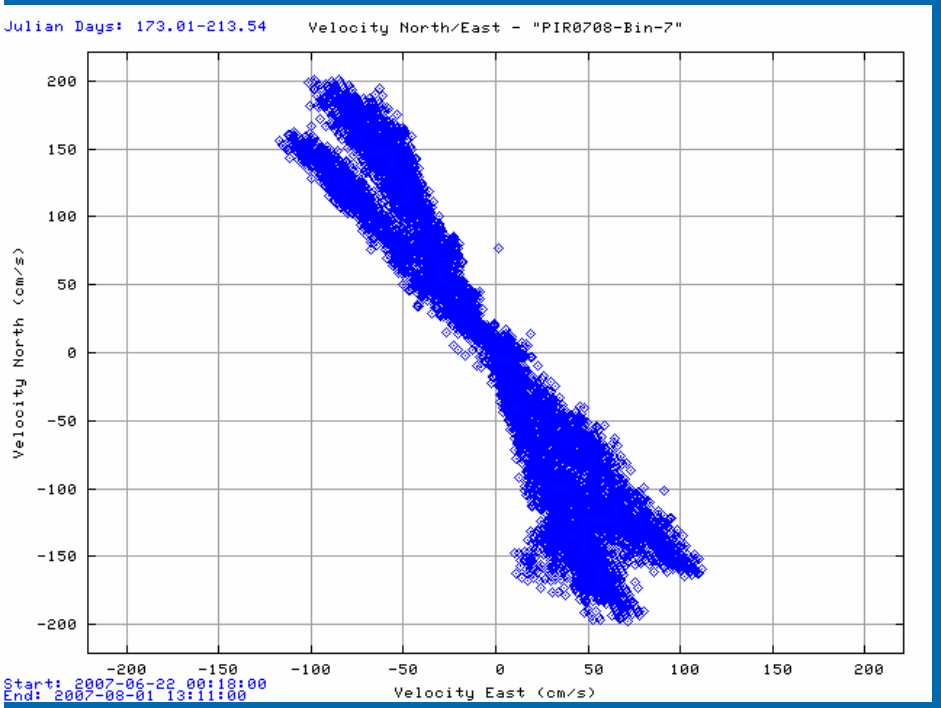


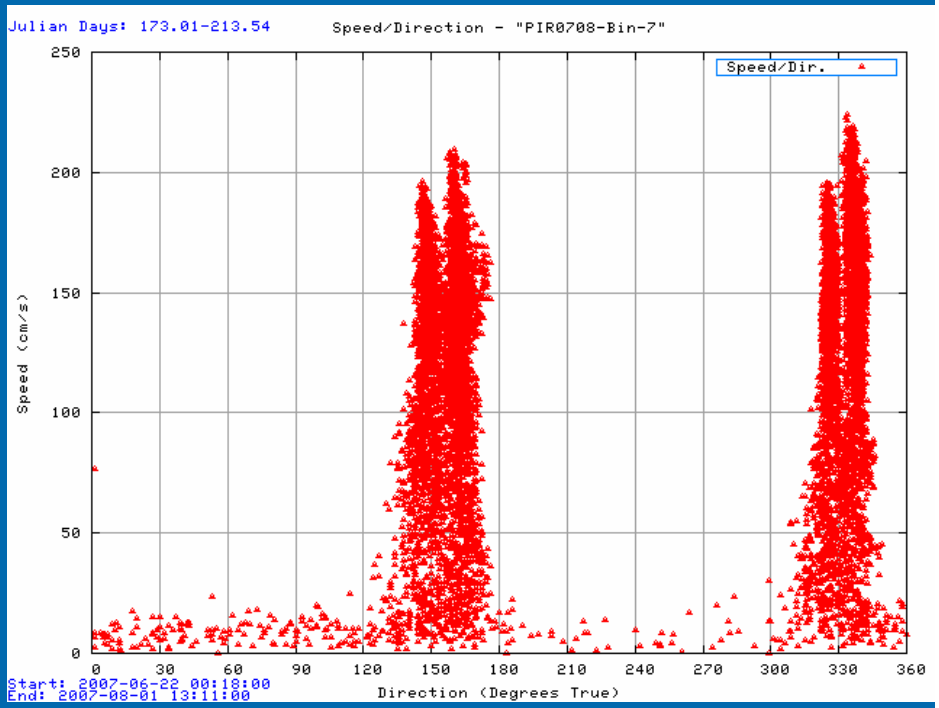
Note: The platform at Schiller Station moved mid-way through the deployment.

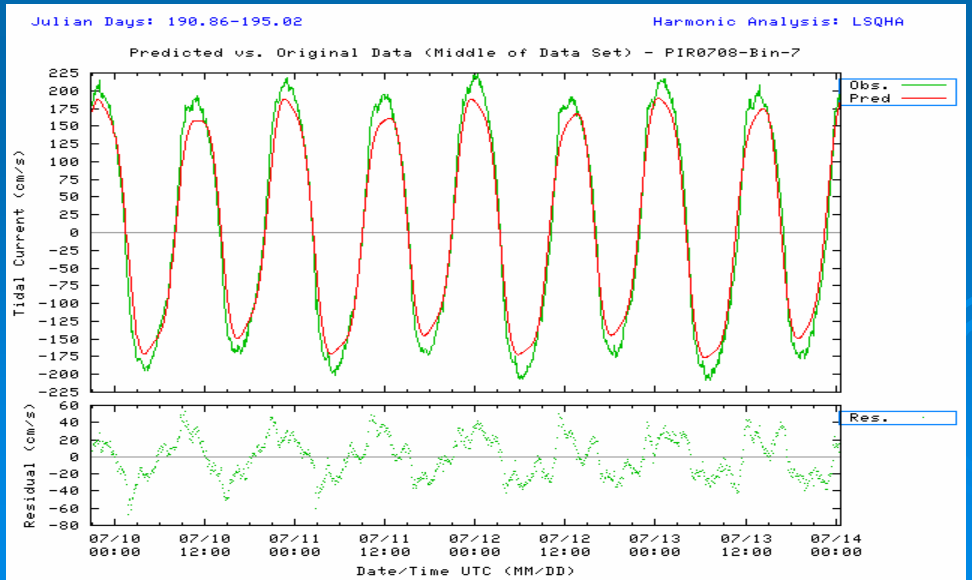
This movement is why there are two lobes to some plots.

The predicted is based on the pre-move data.

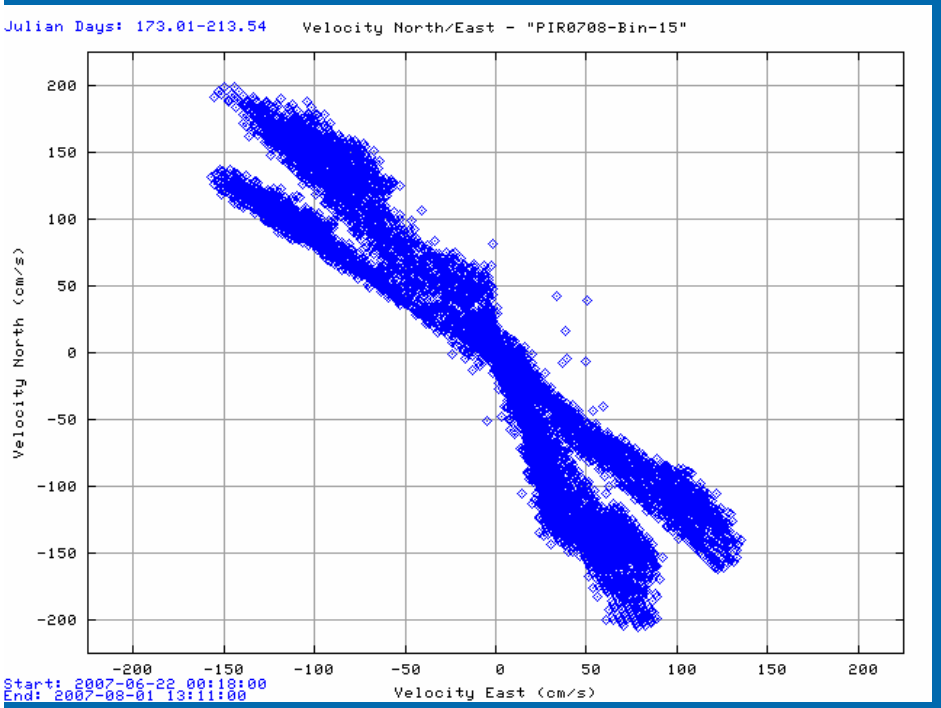
Schiller Station - bin 7 (32 ft below MLLW)

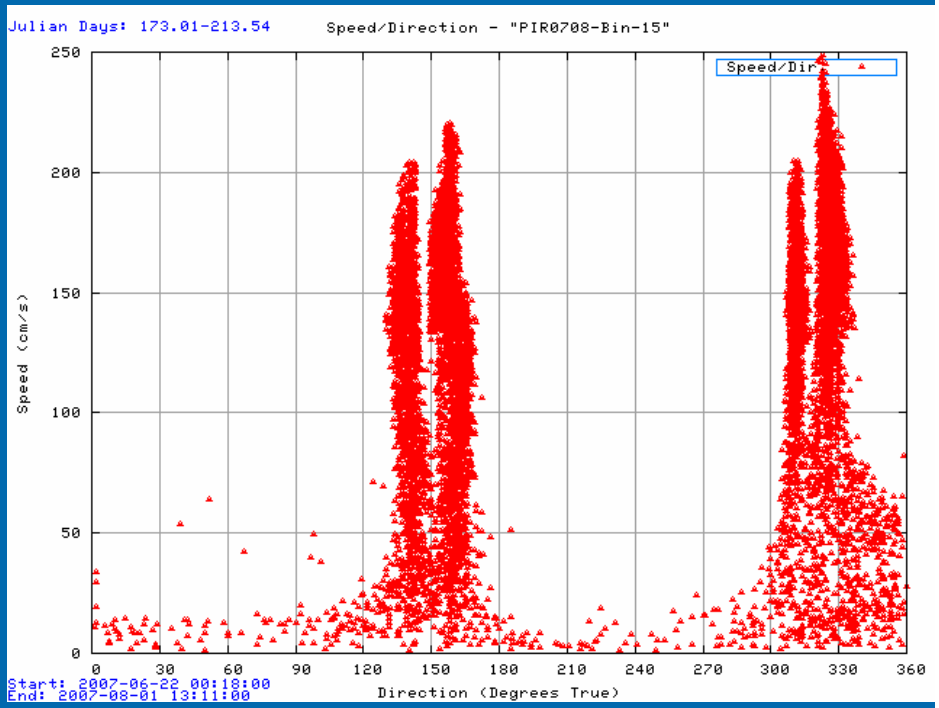


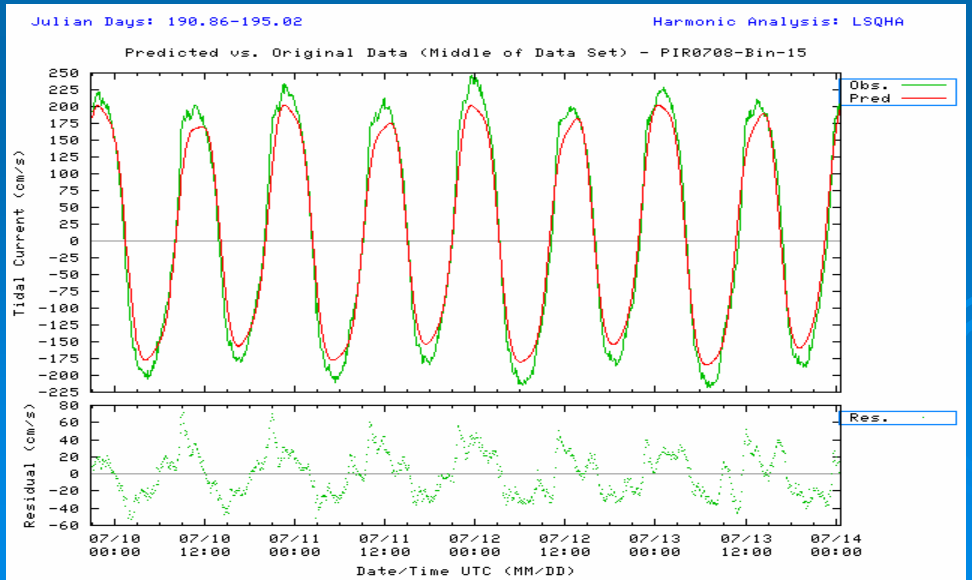




Schiller Station - bin 15 (uppermost good bin: 6 ft below MLLW)







Frankfort Island & The General Sullivan Bridge

The Frankfort Island and General Sullivan Bridge stations should be recovered soon. If the stations have data, they can be made available after an initial review.

Questions?